



**A COMPARATIVE STUDY OF KC-135 OPERATIONS
IN VIETNAM, DESERT STORM, AND ALLIED FORCE**

GRADUATE RESEARCH PROJECT

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Abstract

This paper examines the operational employment of the KC-135 in three major conflicts. Air refueling is central not only to the tactical operations of a campaign, but the strategic goal of supporting two near simultaneous wars. The efficient management of the tanker fleet is required, to ensure the nation's ability to achieve that goal. Examining the three major combat operations the KC-135 has participated in provides some insight into the issues and potential solutions faced by previous commanders and planners. Learning those lessons may benefit future commanders.

An overall review of the development of air refueling in the United States reveals the influences that shaped the issues still surrounding the tanker force today. Justified under strategic support to the Single Integrated Operational Plan, the strategic implications of air refueling have put the KC-135 commanders at odds with the tactical commanders conducting the three air campaigns to one degree or another.

An historical review of these three diverse air campaigns shows similarities in basing problems, the impact of weather, crew to aircraft ratios, and distance and air space limitations. It also reveals some differences in organizational design, supervision at the headquarters, and approaches to planning. In each case there was an initial effort to plan tankers against specific missions. In the earlier two conflicts, the planners adjusted this approach to treat the fuel available and required in the aggregate. Finally, very little information is collected to critically evaluate the efficiency of a tanker force, and the paper recommends some alternatives.

Young Tigers

The long haul now is over
And the Young Tigers must withdraw;
But they stand ever ready
To extend their mighty paw.
Ask any fighter jock
As he was very well aware –
That when he hollered “Bingo”
A Tiger was always there.

It’s not just the end of a story,
Merely the turning of a page.
The Young Tigers will again get their glory
When they hear that furtive plea –
“I’m down to almost zero
and I’m hurting mightily.
Have you a little extra gas
So I can make one more pass?”

The answer is always the same,
“Sure, we can play that game.”
And the boomer very steady,
Will call “Tanker ready.”
And a debt to freedom is paid
When he says “Contact made.”

-- Colonel George A. Dugard

A COMPARATIVE STUDY OF KC-135 OPERATIONS IN VIETNAM, DESERT STORM, AND ALLIED FORCE

I. Introduction

General Issue

The air war over Serbia, known as Operation Allied Force, is the latest installment in an ever-growing list of air campaigns dating back to the aircraft's introduction to combat during the First World War. The evolution of employing aircraft in a contingency is as amazing and complicated as the machines themselves. The lone reconnaissance aircraft, fighter patrols, and limited bombing attacks across France and Germany have developed into a sophisticated, closely orchestrated dance involving a multitude of specialized aircraft. Each component must achieve a level of success if the action is to succeed. Air refueling is no exception. The U.S. Joint Forces Air Component Commander (JFACC), Operation Allied Force, Lieutenant General Michael Short underscored this point, when he stated "Without tankers we could not have fought this war" (HQ USAF, 1999).

However, achieving the requisite success in air refueling operations was not without some significant challenges during the war. Secretary of Defense William S. Cohen and Chairman of the Joint Chiefs of Staff, General Henry H. Shelton's joint statement to the Senate Armed Services Committee articulated just a few of the problems. "The deployment to Europe of aircraft based across the world, coupled with the wide range of bases used by combat aircraft in theater, made aerial refueling a

challenge.” The secretary also pointed out the difficulties associated with the basing of tanker aircraft, crew manning levels, and our ability to plan in theater, in real time, for the most effective use of the tanker fleet (Cohen, 1999:12). Each of these factors had to be addressed on the tactical level in order for the campaign to be successful, but the solutions to the tactical problems also have a strategic impact.

Secretary Cohen and General Shelton’s joint statement identified the issue and the impact of the tactical solutions on the bigger picture.

To begin, we must be clear about our strategy and what this means for the nation. As a global power with worldwide interests, it is imperative that the United States, in concert with allies, be able to deter and defeat large-scale cross-border aggression in two distant theaters in overlapping time frames. In short, we must be able to fight and win two major theater wars near simultaneously.

However this national strategy was jeopardized by the air campaign in the Balkans.

“Consistent with our defenses strategy, U.S. forces could not have continued the intense campaign in Kosovo and, at the same time, been prepared to fight and win two major theater wars” (Cohen, 1999:8). The level of Air Force effort in Europe was so demanding that the U.S. military was forced to accept increased risk levels in other theaters, and repositioned units for quicker response times. The tanker assets were no longer readily available to deploy U.S. based forces to potential trouble spots, such as the Korean Peninsula. This is only one indication of the far-reaching impact the war in Serbia had on the U.S. military.

United States Air Forces in Europe, vice-Commander, Lieutenant General Begert illustrated the level of effort through a comparison with both the Vietnam War and Operation Desert Storm. During Vietnam 13% of the KC-135 fleet was committed to the war effort. During Operation Desert Storm 42% of the fleet was involved and Operation

Allied Force called on 43% (Begert, 1999). These numbers indicate a high demand, and on the surface appear to indicate something else about each of those conflicts. It would appear that while Desert Storm and Allied Force were nearly equal in the scope of the air campaign, both were significantly more intense than the air war in Vietnam.

Problem Statement

The United States' tanker fleet plays a critical role in the national strategy to support two near-simultaneous major theater wars, and a vital role in the tactical support of combat operations. The importance of this asset, at both levels, requires that its employment be handled with care. An operation the size of Allied Force required a commitment of assets that raised the level of risk to other theaters and exceeded the demands of Desert Storm. The salient question is; how does the Air Force know if it's KC-135 fleet is being employed in the most efficient manner possible, while still achieving the nation's political and military objectives?

Research Objectives

Every operation, peacetime or war, is a unique and dynamic situation. There is no one right answer, and a rigid prefabricated approach is unlikely to succeed, but there are lessons to be learned from every experience. Although the settings may change, some core issues consistently repeat in each campaign. The value of evaluating and comparing previous operations in search of themes to apply to future operations goes back to Jomini's review of the Napoleonic campaigns and continues to this day.

A review and comparison of the major tanker operations can provide similar insight. Vietnam, Desert Storm and Allied Force are the major tanker operations. These three conflicts couldn't be more different in many respects and yet there are some amazing similarities present in all three. These similarities can offer planners and future commanders a look at the past difficulties, strategies, and techniques and provide a yardstick to measure their situation against.

It is important to note that a review of past operations requires an evaluation of decisions and their outcomes. It is not a judgment on the decision, and certainly in hindsight it is nearly impossible to appreciate the full context of the situation in which those decisions were made. The purpose of gleaning lessons from previous operations is to ensure success in the future. It is equally important to ensure that the tools are in place to allow for an adequate evaluation of each conflict.

Research Questions

To investigate the question of whether or not the KC-135 force was efficiently managed during Allied Force, it is necessary to define both management and efficiency. Webster's Third International Unabridged dictionary defines management as, "the executive function of planning, organizing, coordinating, directing, controlling, and supervising" (Websters, 1993:1372). The definition of efficiency is the capacity to produce desired results with a minimum expenditure of energy, time, money, or materials (Websters, 1993: 725).

The efficient employment of the KC-135s, in any of the conflicts, is dependent on how they are managed by their controlling agency. Although the deployed forces during

Vietnam were still controlled by Strategic Air Command (SAC), their planning, directing, and coordinating were accomplished in the theater. Headquarters SAC was content to allow their deployed commanders and Pacific Air Forces (PACAF) to manage the assets. In Allied Force operational control was turned over to the theater. Management is the independent variable and can vary between operations.

Examining how the tanker force was managed during each of the three conflicts is the easier of the two tasks. Capturing data on the organization, coordination, direction, planning, and supervision requires relatively little individual interpretation. The first question is how was the tanker force organized at both the headquarters and the unit level? Second, who supervised the force and what was the nature of that supervision? Coordination and direction are contained both within the supervisory actions and the planning process, and will be addressed within those areas. The planning functions, depending on how they are executed, will either coordinate and direct the actions of the units or create a void. That then brings the third investigative question forward, what was the planning process?

Efficiency is a tough issue to measure, and even tougher to agree on an evaluation criteria. Lieutenant General Begert encapsulated the war fighter's perspective of efficiency when he stated, "the emphasis of combat operations on mission effectiveness over efficiency also required a larger force than might have seemed necessary" (Begert, 1999:5). The United States General Accounting Office measured the efficiency of tanker operations in Desert Storm in terms of unused fuel on each sortie. "Unused fuel is an indication of the inefficiency of tanker operations – that is, the match between the fuel available aboard tankers and the fuel actually required by receiver aircraft" (GAO,

1993:1). Efficiency, for the purposes of this paper, is utilizing the minimum amount of resources to achieve the desired outcome. In the case of Allied Force, according to Lieutenant General Begert, the tanker force structure would have been efficient because that was the size required to be effective in that given situation.

Research Limitations

The efficiency measure is extremely subjective. Each of the various stakeholders will have a different idea of what the minimum number of resources is to accomplish the mission. A portion of this subjectiveness is apportioned to the vagueness of the mission. Would Allied Force have been more efficient if they used half the number of tankers, but took twice as long to achieve the political objectives? Given the innumerable factors that influence combat operations it is nearly impossible to predict an outcome after changing a few minor inputs. Hopefully the comparison with other similar sized, yet tactically diverse, operations can serve as somewhat of a control group. There is a lack of established criteria for evaluating the efficiency of tanker operations in a systematic fashion. The Air Force has made no effort to establish a set of criteria, or put them to use in tanker operations.

The research is limited in scope and depth given the narrow focus of the paper. There are certainly many other issues that could affect force sizing and structure other than the planning, organizing, and supervision methods and processes used. However, the paper examines only those factors, as they have historically been involved in managing the Stratotanker, and leaves the other areas to future research. It is also difficult to capture the actual processes, rather than the theoretical processes, through

after action reports and command briefs, even though the informal processes can have a big impact on the final outcome. Without conducting numerous interviews, it would be very difficult to establish the informal networks or channels that were used to manage the force. Although the authors of the Gulf War Air Power Survey were able to capture some of this type of information following Desert Storm, it is limited to the strike targeting processes and not the air refueling planning process.

One final limitation is the actual comparison of these three operations. They are the most substantial tanker operations since the concept has been implemented, and although there are numerous similarities, and the people involved had to tackle many of the same issues, the contexts are different. Time could be the most obvious example. Vietnam lasted for ten years. This gave PACAF the opportunity to program for improvements to the infrastructure, whereas Allied Force had to make do with what was on-hand. Although the varying lengths of each conflict do introduce some limits on making comparisons, it is possible to address this difference. For instance, in the Vietnam basing example, there were times when the force was quickly expanded to deal with a surge in operations and were forced to use airfields in disrepair. In any case, the impact of the time differential needs to be considered.

Methodology

Most of the data gathered has come from after action reports and command briefings. In the case of Vietnam, there is little information readily accessible outside of this format. Fortunately, those reports are fairly detailed and address the elements of managing the fleet, as earlier defined. Desert Storm's records are more current and

detailed. However, given the proximity to Operation Allied Force, much of the information associated with that action, has yet to be captured and disseminated. Much of the insight into how the KC-135's were managed comes from interviews and command briefings by some of the key participants.

Comparing these three operations in terms of the independent and dependent variable requires some adjustment. Although the KC-135 was used in each of these fights, it is not the same plane in any of them. During Vietnam all of the airframes carried the J-57 engine, which equates to less thrust and thus less payload. During Desert Storm there was a mix of J-57 airframes and the CFM-56 engines or R model, as well as the E model KC-135s, and Allied Force had only the R and E models available. The CFM-56 provides 10,000 pounds more thrust per engine, and under most conditions will allow the aircraft to carry 20,000 to 30,000 pounds of additional fuel. The factors that affect aircraft performance are going to impact the available payload – pressure altitude, temperature, and runway available being the most crucial. The disparity in capability must be included in any analysis of the number of tails used to provide a given amount of fuel.

There are considerations other than just taking off with the maximum load possible. The number of tankers available simultaneously is a major concern for the receiver aircraft. This is known as “booms in the air.” This limitation needs to be accounted for in the final analysis of overall efficient force sizing. The need for a certain number of booms can drive up the aircraft requirement as much as the amount of fuel needed aloft. Additionally, the comparison is not how many R models could have accomplished the same missions in Southeast Asia, but how did each operation utilize the

assets they had available to deal with the requirements. Examining the operations from this perspective will help identify possible standards to measure all operations against.

Implications

Aerial refueling will continue to be a part of any major campaign, and any future commander will have to deal with the same issues those of the three previous wars faced. Analyzing their situations and their solutions will allow that future commander to base his decisions not only on his experience, but those of his predecessors as well. Reviewing these lessons prior to the next conflict may prevent making decisions in the face of a rising crisis, and may even allow for a systematic approach of limiting the impact of these core issues. In a time of limited resources, the efficient management of a precious resource is vital. Hopefully this research will provide a little more insight into how others have addressed that problem.

II. Literature Review

Historical Perspective on the Development of Air Refueling

As with many innovations, the idea of refueling aircraft in flight was developed in wartime. In 1917 a Russian Navy pilot, Alexander Severesky, proposed a system for in-flight refueling, and although it is doubtful that the Russians exploited the idea at the time, there were numerous post-war experiments. A U.S. Navy lieutenant, Godfrey L. Cabot, developed a method for snaring gas cans from floats, and Severesky, after immigrating to the United States, applied for the first patent of an in-flight refueling system, in 1921 (Byrd, 1994:17).

On October 25, 1923, Captain Lowell Smith and Lieutenant John Richter proved not only the capability of aerial refueling, but also the concept of operations to come. On this day they took off from Sumas, Washington, near the Canadian border, and flew to Tijuana, Mexico for a total distance of 1,200 miles. The sortie was accomplished by pre-positioning tanker aircraft at Eugene, Oregon and Sacramento, California (Byrd, 1994:22). The need for prior coordination to strategically locate the tanker aircraft has continued to be a fundamental concern when employing the tanker.

The historic flight of the Question Mark in 1929 firmly established an advanced and reliable method for accomplishing in-flight refueling. Major Carl Spaatz, Captain Ira Eaker, and Lieutenant Elwood Quasada set the endurance record on January 7, 1929, of 150 hours, 40 minutes, and 15 seconds (Byrd, 1994:31). Although this flight was not the first successful example of refueling, and the endurance record did not stand for long, it did move the concept from being a stunt to a legitimate tactic for employing aircraft.

With this newfound legitimacy, aerial refueling entered a developmental stage where numerous countries and aviation teams tried to outperform each other with record setting flights and newer technologies. Despite the excitement that was generated by these flights, progress towards mainstream operations was slow.

While the coming of World War II did not stop research, it did lower the emphasis. In the Pacific, island hopping and carrier aviation were the solutions for limited ranges, and in Europe the bombers were able to strike most European targets from their bases in Great Britain and North Africa. The escort aircraft in Europe were plagued with range limitations until the arrival of more efficient designs combined with drop tanks to carry additional fuel. The British were the only nation to continue to conduct substantial research into the concept during the war. Although their advances did not enter mainstream operations during the war, the foundation was laid for the post-war rise of air power (Byrd, 1994:62-66).

Two key events took place in 1946 that would further the development of air refueling in the United States Air Force. The first was the creation of Strategic Air Command within the Army Air Corps, and the second was the appointment of General Carl Spaatz as Commander General of the Army Air Forces. Immediately following the creation of the Air Force as a separate military branch, the Navy challenged the Air Force to become the principle manager of the nation's nuclear capability. Their arguments attacked the Air Force where they were most vulnerable, the need for sensitive forward basing of strategic bomber aircraft. In light of this attack, Air Force Secretary Stuart K. Symington testified before the Senate Armed Services committee that the B-29's range could be significantly extended through in-flight refueling. This put pressure on the Air

Force and Boeing to demonstrate the capability. They succeeded on March 28, 1948. By mid-1948, the newly created U.S. Air Force was taking delivery of their first mainstream refueling aircraft, the KB-29M, a derivative of the World War II bomber. These aircraft employed the basic rendezvous and refueling methods developed by the British over the previous ten years (Byrd, 1994:69).

As the Air Force's principle agent for the strategic bomber force, Strategic Air Command became the key player in the development of air refueling with the goal of increasing the range of the U.S.'s bomber fleet. The limitations of the existing airframes, and the British grapple and hook method were obvious from the start. Boeing began a study in April of that same year to address 1.) Reducing the performance penalty of piston tankers refueling jet bombers; 2.) Achieving a satisfactory position for the receiver aircraft during contact and refueling; 3.) Increasing the fuel flow rate beyond the slow gravity-fed rate; and 4.) Developing visual and electronic means to facilitate the rendezvous. The contact position and fuel flow problems proved the easiest to overcome. By late 1948 Boeing had developed the "flying boom", which is the fundamental design in use today. This rigid pipe allowed the receivers to achieve a stable position directly behind the tanker, out of his wake turbulence, and insulated the fuel from the cold atmosphere (Hopkins III, 1997:19-21).

The limitations in performance would take longer to correct. Ironically, the first operational employment of aerial refueling was during the Korean War to fighter aircraft, not strategic bombers. Project 'Hightide' was a three-phase program designed to evaluate the feasibility of air refueling in a combat environment. The receivers consisted of F-80s and F-84s, and the project ended with the theater requesting more tankers to

support growing requirements. Despite the success of the test, the tanker's operational concept was to support strategic bomber operations and the KB-29s were insufficient to meet the needs of the B-47s. Strategic Air Command converted Boeing's C-97 Stratofreighter into the KC-97, but its performance was just barely within that required by the B-47, and unsuitable for the next generation bomber, the B-52. Boeing took the initiative and developed the Dash 80, which would become the prototype for the KC-135 (Hopkins III, 1997:24).

The conflict between the strategic and tactical roles of in-flight refueling became a topic of serious debate for the first time in the late 1950s. Tactical Air Command (TAC) having witnessed first hand the leap in capability tankers offered during the Korean War had acquired converted B-50s as tankers, but their performance (much like the KC-97) was unsuitable for the next generation of fighter aircraft. By this time the KC-135 was in full production, and the success of the airframe was becoming obvious. TAC Commander, General Otto P. Weyland, testified before the House Defense Appropriations Committee, "TAC needed a jet tanker and [Weyland] would give its acquisition top priority even though it was not a combat airplane. Such a tanker was needed to provide the mobility to get tactical forces to the right place at the right time" (Hopkins III, 1997:24). General Curtis LeMay had initiated the KC-135 acquisition program while he was the commander of Strategic Air Command, and now as the Air Force vice Chief of Staff, he resisted TAC's plan. General LeMay viewed two tanker fleets as redundant and unnecessary. Therefore he advocated, 'a single tanker force equipped to provide support to all combat operations requiring air refueling.' Thus on 3 May 1960, General LeMay announced that 'a single tanker force, SAC managed and KC-

135 equipped' would support both SAC and TAC training and combat needs (Hopkins III, 1997:24). This decision would shape the utilization struggles of the KC-135 fleet through the next 40 years.

Overview of KC-135 Operations in Vietnam

Strategic Air Command's involvement in Southeast Asia coincided with the KC-135's first-ever employment in combat operations. On June 9, 1964, almost two months before the Gulf of Tonkin Incident, at 0101z four KC-135s departed Clark AFB in the Philippines to refuel eight F-100s near Da Nang (Hopkins, 1979:4). As has become typical of tanker deployments, this mission came less than 48 hours after the initial notification by the Joint Chiefs of Staff. Upon arrival at Clark, the force was put into a thirty-minute alert status. This small force was known as the Yankee Team Tanker Task Force. Yankee Team was the name for the Air Force element in theater, and as the build-up began following the Gulf of Tonkin resolution, the YT came to stand for Young Tiger, a name that would apply to tactical air refueling operations throughout the nine year history (Hopkins, 1979:2).

On August 5, 1964 the Joint Chiefs of Staff directed 8 KC-135s deploy to Clark AFB and at the same time, TAC initiated the movement of 84 tactical aircraft, involving the support of 48 KC-135s. The eight task force tankers provided 29 air refuelings in the first eight days. The air bridge staged out of Hickam AFB, Hawaii, and Andersen AFB, Guam, and provided 172 air refuelings to move the force. Although the question of basing the force came up almost immediately, Yokota AB was unsuitable and Andersen was too far away to support combat operations, the proposed solution was not to be

implemented until January 1965 (although PACAF hoped to have the issue resolved by early December 1964).

The tanker task force's mission was broken into three priorities at this time. Support would go first to day-to-day operations in Southeast Asia. Second, the aircraft would support PACAF theater training to bring those units up to speed on air refueling. Finally, the tankers were placed in theater to prepare for the anticipated use of B-52s in the war (Hopkins, 1979:7). It was also during this year that the Air Force received its final KC-135, bringing the total to 732 KC-135A models (Logan, 1998:42). The close of 1964 would see the tanker effort switch from a task force type of operation to an organized combat force.

Tanker Organization in the Vietnam War

On January 12, 1965 the 4252d Strategic Wing (SW) was stood up at Kadena AB, Japan. This wing fell under the 3rd Air Division (AD) based at Andersen AFB, and reported directly to Headquarters SAC. For the first time, 3 AD would be responsible for KC-135 operations in the Pacific. Figure 1 depicts the organizational structure during the initial stages.

Strategic Air Command
Offutt AFB NE

Pacific Air Forces
Hickam AFB HI

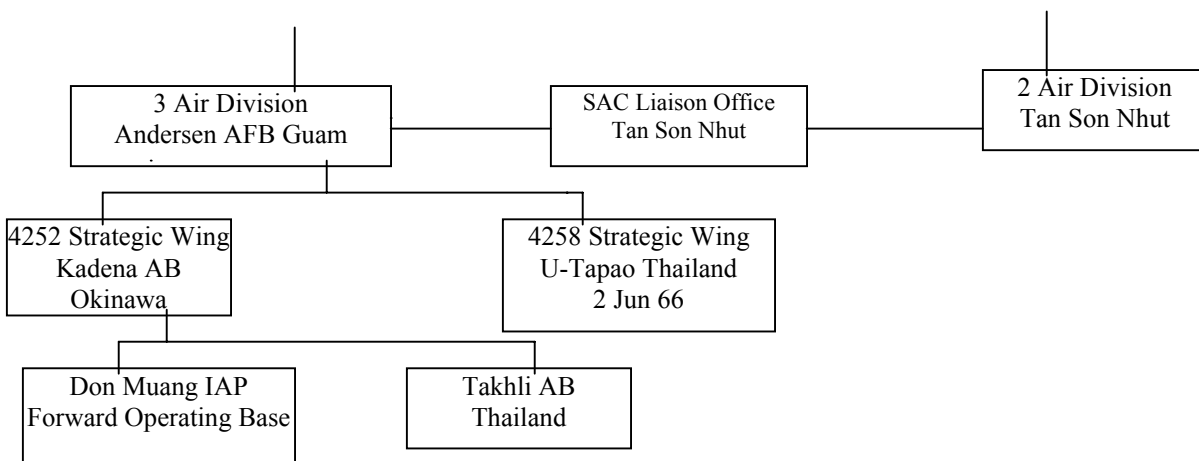


Figure 1. KC-135 Organization 1964-1966

The build up of 15 aircraft over a month, proceeded very smoothly, but with the initiation of Arc Light, the use of B-52s in Southeast Asia, Kadena underwent a transformation similar to those experienced in Desert Storm and Allied Force. The wing was notified on February 11 of the impending deployment, and the first of thirty-two Stratotankers began arriving at 1454z on 12 February. The entire force closed within 17 hours when the final aircraft arrived at 0754z on February 13, 1965 (Hopkins, 1979: 10). The plan called for each aircraft to turn and be ready to fly an operational mission within four hours of arrival. The unit was unable to meet this deadline, and according to the commander, Colonel Morgan S. Tyler, Jr., “rampant confusion” resulted. Colonel Tyler attributed the confusion to five factors. First, 3 AD kept knowledge of the contingency plan from 4252d personnel until the last minute. Second, the last minute deletion of B-47s from the bomber force eliminated many of the necessary staff people from the deploying force. Reducing the staff resulted in fewer planners and support personnel to help run the operation. Third, the limited number of people present with the 4252d had been on

continuous duty too long, and were fatigued by the time they had a chance to review the plan. Fourth, there were numerous changes to the plan as it had been written, and limited guidance on those changes. Finally, Kadena was saturated, and the host units had failed to adequately plan for a SAC contingency (Hopkins, 1979:13).

On 1 March 1965 four of the Clark AFB aircraft moved to Don Muang International Airport (IAP), Thailand (the remaining two moved to Kadena, Clark having previously dropped to a six aircraft operation) as a forward operating location for the 4252d, where they serviced fighter aircraft belonging to the 2nd Air Division. The 2nd Air Division reported to PACAF and controlled all aircraft operating in the war except the Navy and SAC aircraft. This organizational separation between the two resulted in SAC establishing a liaison office (SACLO) at 2 AD headquarters in Saigon. The SACLO was responsible for passing on air refueling requests to 3 AD and eventually directly to the wings. They also had the responsibility for educating the other units about tanker operations. The air refueling requirements were determined by 2 AD personnel and submitted to the SACLO. At this point the office would determine tanker priorities, eliminate those requests that could not be filled, and issue the tasking to the tanker force. Initially the taskings contained TOP SECRET material and would be sent first to 3 AD headquarters on Guam, and then through channels down to the wing at Kadena. This process was causing lengthy delays, particularly when coupled with late changes in the tactical plan due to weather and unsuccessful strikes. At one point Kadena launched 14 of 21 tasked aircraft within 3 hours and 50 minutes of receiving the order. By removing extraneous information from the order; the SACLO was able to drop the classification to

SECRET and transmit the taskings directly to the wing, saving valuable time (Hopkins, 1979:26-28).

Even though all of the tankers were placed under one commander at 3 AD, this didn't completely simplify the mission. On paper, the aircraft were divided by the missions they were designated to support. By mid-1965 there were 45 aircraft assigned to Kadena, of which 15 were to support the Young Tiger or tactical missions and the remaining 30 were supporting the Arc Light, or B-52 sorties. The Arc Light planning took place simultaneously at Andersen and Offutt, based on informational copies of Commander, U.S. Military Assistance Command, Vietnam's (COMUSMACV) request to CINCPAC for bomber strikes. An informational copy was also sent to the Joint Chiefs of Staff for approval, but the planning assumed that approval would be given. The resulting support stood in stark contrast to the division of forces. Only 35 percent of the force were actually supporting SAC missions, and the remaining 65 percent were supporting PACAF (Hopkins, 1979:15). This reality caused 3 AD to remove any distinction between crews other than on paper (and a difference in rotation cycles between the two operations), and treat them as a pool capable of supporting any mission type.

A visiting team from Headquarters USAF recommended that operational control of the tankers be placed under 2 AD. According to Colonel Tyler, "the 2d Air Division and PACAF people concerned vetoed' this suggestion because they recognized the tremendous support SAC, as single manager could provide with its tankers to all commands, in CONUS and Europe as well as Southeast Asia" (Hopkins, 1979:43). SAC was also opposed to handing over operational control of the aircraft, and given the fact that PACAF was generally pleased with the responsiveness of the tanker force, it stayed

with SAC through 3rd Air Division. In 1967 the detachment at Takhli moved under the 4258 SW at U-Tapao, who assumed control of the tankers in Southeast Asia.

Additionally, the SAC Liaison Office officially became the SAC Advanced Echelon (ADVON) in anticipation of increased operations. When the 4220 Air Refueling Squadron stood up at Ching Chuan King, Taiwan, they fell under the 4252 SW at Kadena. On 1 April 1970 the entire structure went through an extensive reorganization. Figure 2 depicts the changes that took place in bold.

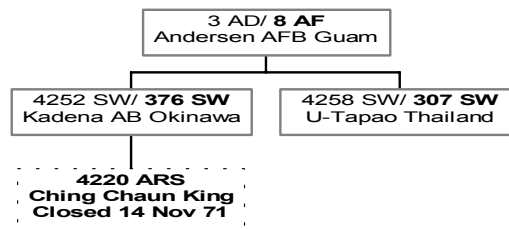


Figure 2. KC-135 Organizational Changes 1971

The struggle for operational control of the aircraft underwent one final battle. Lieutenant General William W. Momyer took control of Seventh Air Force (the previous 2 AD) and set about bringing all of the assets used by 7 AF under his authority. This included the tankers, bombers, and C-130s. SAC refused to release the tankers for several reasons. SAC viewed the tanker units as part of a whole strategic fleet, whose primary mission was to support a general war. Thus they were reluctant to expose the aircraft to increased risk, and potentially impact their ability to support that war. The second point was the scheduling or distribution of fuel. SAC planners estimated they could supply 1.8 million pounds of fuel if the refuelings were spaced at 40 percent in the morning, 40 percent in the afternoon, and 20 percent in the evening. However, the fighters would mass the

strike packages to simultaneously hit multiple targets, and thus could only use an average of 1 million pounds. The differences between PACAF and SAC were fundamental to the employment of the force. Perhaps the most important insight comes from Strategic Air Command's review of operations in the war.

At first, PACAF tended to talk of its refueling requirements in terms of the number of tankers needed to provide a certain number of tactical aircraft with so many gallons of fuel. SAC, on the other hand, approached refueling requirements on the basis of how many sorties were needed to offload the required fuel as calculated in pounds, rather than in the specifics of how many aircraft would be needed to fly the sorties or the fuel capacities of various receiver aircraft on specific missions; it was a subtle difference in approach, but an important one. Gradually, all concerned came to adopt the SAC approach in discussing the subject (Hopkins, 1979:43).

Although both Strategic Air Command and General Westmoreland, COMUSMACV, prevented the move to transfer operational control, General William Crumm, 3 AD commander, recognized that some changes were in order to increase flexibility (Hopkins, 1979:57-59).

The final major reorganization took place in 1972 as the air campaign geared up for its most intense phase throughout the course of the entire war. The subsequent build up of forces required the use of every location previously supporting tanker operations. As each base or operating location expanded, 8 AF kept the Southeast Asia tankers under the 307th, and the rest stayed under the 376 SW (Hopkins, 1979:88). The final structure is depicted in Figure 3.

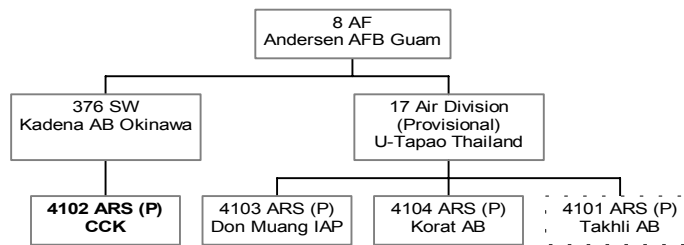


Figure 3. KC-135 Organization 1972

Vietnam Basing Issues

The location and composition of KC-135s throughout the theater would ebb and flow with a variety of factors. Political constraints, weather, operations tempo, and infrastructure limitations would continue to affect the force during the course of the war. A number of locations were opened up under the assumption that it was a temporary arrangement, only to become a main operating base. The trade-off between basing and available offloads was also an important consideration throughout the war. Table 1 provides a breakdown to the locations, key missions, and nicknames associated with each base. Although a variety of names and task forces appear, the key is that Arc Light and Jumping Jack were the names for the strategic bombing missions, and all of the others supported PACAF operations.

Table 1. KC-135 Locations, Missions, and Operation Names

Name	Primary Base	Mission
Lima Mike		Pacific Fighter Deployments
Yankee Team	Clark AB	Tactical strikes in Laos
Foreign Legion	Clark AB	Renamed from Yankee Team
Tamale Pete	Kadena AB	Okinawa TTF
Young Tiger	Kadena AB	Tactical Operations in SEA
Tiger Cub	Don Muang IAP	Relocation of Foreign Legion
Arc Light	Kadena/Ching Chuan King	B-52 Operations in SEA
King Cobra	Takhli RTAFB	Supplement Tiger Cub
Giant Cobra	U-Tapao RTNAB	Supplement Tiger Cub
Jumping Jack	Arc Light bases/ Andersen	Post-mission B-52 refuelings
Glass Key	Ching Chuan King	Supplement Young Tiger/Arc
Bullet Shot		Deploy B-52/KC-135 to SEA
Constant Guard		Deploy tactical aircraft to SEA

As the emphasis on tactical air refuelings grew during the course of the war, so too did the emphasis to locate the tankers closer to the users. By mid-July of 1965 the Kadena based tankers were flying 22-26 sorties a day, and the four at Don Muang were flying 8 sorties a day. There was enough information available to conclude that the Southeast Asia tankers were able to supply two to three times the amount of fuel as those flying from Kadena. SAC and PACAF meet in Hawaii with the goal of improving tanker support. The attendees determined that ten Thailand based tankers could supply the same amount of fuel as twenty-two based out of Okinawa (Hopkins, 1979:45). The result was

a construction plan that would take until 1966 to complete and would open U-Tapao as a KC-135 base.

Although this was a good long-term solution, the CINC needed some shorter-term options to improve offloads. The operations tempo was rapidly increasing and correspondingly so was the demand. Operations at Don Muang had increased fourfold, and Okinawa was ten times higher than planned. Even before the conference had ended the request for ten tankers in Thailand had jumped to 17. Headquarters USAF was trying to hold down the number of tankers in Southeast Asia, ostensibly to downplay the U.S.'s overall role in the growing war. The emphasis to hold down the number of committed resources in conjunction with ever-increasing requirements put pressure on HQ USAF to "use the KC-135s already present to their maximum efficiency" (Hopkins, 1979:46). The situation was so tight that there were discussions of limiting individual B-52 sorties.

The planners' desire was to expand operations at Don Muang, but before the ambassador could even make the proposal, the Thai government expressed concern about the number already at the airport. The result of that meeting was a plan to move three, and eventually ten tails to Takhli. Although Takhli did bring more KC-135s in closer to the tactical receivers, there were still infrastructure problems to overcome. In order to support the tankers, Takhli needed ramp and support facility construction that would take three months to complete. The result was that the aircraft were phased in; three in September, two more in October, another in November, and they reached full strength on December 20, 1965. Takhli also offered Kadena some relief in night operations that Don Muang could not. The final major obstacle for operations at Takhli was fuel. The fuel

supply had to be trucked in from Bangkok every night via the “Red Ball Express” (Hopkins, 1979:48).

As 1965 closed out, the KC-135 was firmly entrenched in the war. There were 55 aircraft in theater. Thirty were designated to support SAC’s Arc Light missions, and the remaining 25 supported PACAF operations, on paper anyway. Forty-one of the aircraft were based at Kadena, including all 30 of the Arc Light aircraft, 10 were at Takhli, and 4 were operating from Don Muang IAP. There were approximately 80 crews supporting the mission, and they were averaging 14 sorties a month, or flying every other day. This equated to a crew ratio of 1.45 crews per aircraft (Hopkins, 1979:37).

The next major development in basing didn’t occur until June of 1966. At this time Takhli received 5 more aircraft to bring it to a new high of 15 aircraft. The 4258th Strategic Wing (SW) was activated at U-Tapao AB. Kadena shifted 5 aircraft to U-Tapao, dropping them to 36 aircraft. Takhli moved 5 from their crowded base, which brought them back down to 10, and 5 additional aircraft rotated in from the United States. This realignment made U-Tapao the main tanker base in Southeast Asia. These numbers were reached in August of 1966 despite large holes in the ramp and only one taxiway connecting to the runway. The plan for early 1967 was to have the 4258th assume command of Takhli and U-Tapao tankers, and close down Don Muang operations (Hopkins, 1979:51).

As the war moved into 1967 the force was growing and relocating closer to the fight. There were now 75 KC-135s in theater. Twenty-seven aircraft were in U-Tapao (having received the Don Muang tankers prematurely due to political pressure), and 8 at Takhli for a total of 35 Young Tiger aircraft. Kadena’s 40 aircraft were designated for

the ever-increasing Arc Light support. Currently bomber sorties were ranging between 650 and 800 a month. Although as B-52s moved to Thailand to operate from U-Tapao, the Arc Light refueling requirements dropped.

Starting as early as 1965, the Air Force worked plans to base SAC aircraft in Taiwan at a base known as Ching Chuan King (CCK). The use of this base was significantly impacted by political constraints and infrastructure limitations. The fuel capacity of the field was sorely limited. The Air Force experimented with a variety of procedures to supply the fuel to include pumping it directly from oiler ships just off the coast, but despite these efforts the limitations would continue to bother operations at CCK throughout its history. PACAF also put pressure on the development of CCK, by planning to place F-111As in Takhli and displace the tanker force to Taiwan (Hopkins, 1979:72).

The 4220th Air Refueling Squadron was activated at Ching Chuan King on February 2, 1968 and fell under the 4252d SW at Kadena. With the seizure of the USS Pueblo and the Tet Offensive, the tanker force grew. As this new squadron was standing up, the breakdown of forces was 39 Kadena aircraft, 32 at U-Tapao, 8 still at Takhli, and 10 at Ching Chuan King. It is important to note that these aircraft represent those being used for combat support air refueling, there were still more KC-135s in theater and supporting aircraft moves. An additional 5 KC-135s at CCK were performing a radio relay mission known as Combat Lightening. Although not a part of the air-refueling statistics, they were using resources and impacting SAC's overall available assets. In January, there were four aircraft deployments requiring the support of 20, 16, 12, and 9

tankers respectively. The movement of tactical aircraft to and from the theater continued throughout the war.

The Takhli tankers were eventually moved to U-Tapao in late February, bringing their total to 40 aircraft, and the daily sortie rate for Young Tiger aircraft went from 53 to 66 (Hopkins, 1979:74). In order to deal with this and the new 1,800 bomber sorties a month, SAC looked to put more tankers into CCK, but the continuing fuel problems and navigational aid limitations restricted them. Political pressure in Japan was also shaping the force location. Japan was pushing to get the B-52s off of Okinawa, which meant placing them at U-Tapao at the expense of the tankers. The total of 94 aircraft in July 1968 dropped to 85 by June 1969. They were distributed as follows: 40 at U-Tapao, 22 at Kadena, 21 at Ching Chuan King, and 2 on strip alert at Andersen. The mission breakdown in sorties per day was 54 Young Tiger refuelings, 22 Arc Light flights, and 11 for various other operations. SAC determined that there were 88 sorties available daily and the average number actually flown was 79 (Hopkins, 1979:78).

A curtailment of operations and extensive repairs at U-Tapao dropped the daily sortie requirement for the tanker fleet. Although CCK was primarily supporting the Arc Light refuelings, they offered three daily sorties to the total of 44. U-Tapao furnished 27, and the temporarily re-opened Takhli operation put up 14 a day. From this point through late 1971, the trend in tanker operations was downward. In June of 1970 there were 71 tankers spread across the theater. U-Tapao held 38, 18 were assigned to Kadena (including the 2 strip alert aircraft at Andersen), and Ching Chuan King was responsible for 15. However, as requirements continued to drop so too did the tanker numbers.

There would be 31 located at U-Tapao and 15 at Kadena in the summer of 1971 (Hopkins, 1979:81).

1972 would prove to be a record setting year for the tanker fleet. As hostilities increased and combat sorties grew, so too did air refueling missions. Beginning on February 8, 1972 there was a rapid buildup of forces and missions. By April of that year the Kadena fleet had swelled to 22 tankers supporting between 60 and 75 sorties a day. The Young Tiger tankers now consolidated at U-Tapao increased to 46 tails. They offered up 60 sorties through the course of a day or 48 during a surge. There were 11 more tankers moved into Clark AB on 10 May to help support the renewed air campaign, and 16 were sent to Takhli, which had fallen into disrepair. The combined force and available missions were as follows: U-Tapao had 46 tankers for 60 sorties, Takhli had 16 tails and 20 sorties, and Clark's 11 aircraft offered 10 sorties for a total of 90 sorties a day. Kadena was also busting at the seams, having grown to 60 tankers supporting Arc Light, the radio relay mission and four strip alert commitments (Hopkins, 1979:86-87).

However the high water mark had not yet been reached. In May, four more tankers were moved into Takhli bringing their total to 20 and offering 24 sorties a day. U-Tapao would remain at 46 and 60 sorties. Clark would go up to 28 aircraft and 25 sorties a day. Don Muang was again made available to SAC, but only after initial objections by the Thai government about the presence of U.S. military aircraft at a civilian airport. Don Muang would support 13 aircraft and 15 sorties. Because of its proximity, and thus potential offload capability, it was highly prized by SAC planners. Finally, Korat took seven aircraft and offered up six daily sorties. The final tally, including the Kadena force, was on average 170 aircraft supporting the Vietnam air

campaign directly. Table 2 gives a break down of the Young Tiger force disposition (Hopkins, 1979:90).

Table 2. Young Tiger Force Disposition in 1972

Base	Aircraft	Crews	Sorties per Day
U-Tapao	46	88	60
Clark	28	37	25
Don Muang	13	23	15
Takhli	20	36	24
Korat	7	12	6
Total	114	196	130

These numbers equate to a 1.7 crew ratio to support the tactical operations.

Unfortunately these numbers do not include the Kadena tanker crews.

This force posted the record setting totals for the entire war. September 1972 would set the mark with a total of 3,902 refueling sorties (2,661 Young Tiger, and 1,241 Arc Light). There were 12,509 individual refuelings to offload 159.6 million pounds of fuel (Hopkins, 1979:94). Although the cease-fire would be signed in January 1973, combat operations and tanker support would continue through August of that year. As the requirement for fuel dropped so too did the number of deployed tankers. The draw down consolidated the tankers at Kadena and U-Tapao. In June there were 52 stationed at U-Tapao and 47 at Kadena. Table 3 provides a look at the average sortie statistics for the course of the war.

Table 3. Vietnam Sortie Averages

	Sorties	Receivers	Offload	Tanker-Receiver Ratio	Offload per Receiver	Offload per Sortie
1965	9,282	31,250	315,000,000	3.37	10,080	33,937
1966	18,203	78,946	851,700,000	4.34	10,788	46,789
1967	22,891	103,415	1,037,000,000	4.52	10,028	45,302
1968	32,000	129,205	1,642,900,000	4.04	12,715	51,341
1969	27,866	138,164	1,433,100,000	4.96	10,372	51,428
1970	19,450	86,431	888,200,000	4.44	10,276	45,666
1971	14,427	62,592	618,500,000	4.34	9,881	42,871
1972	34,728	115,272	1,438,500,000	3.32	12,479	41,422
1973	15,603	67,655	726,700,000	4.34	10,741	46,574
Totals	194,867	813,878	8,963,700,000	4.18	11,014	45,999

Vietnam Air Refueling Policies and Restrictions

The first considered look at the air refueling plan came after the very first Arc Light mission during which two B-52s collided in the air refueling area. The accident resulted in the establishment of multiple tracks at varying altitudes, greater lateral separation between the tracks, and instituting timing triangles to adjust timing on the approach. However, congestion from commercial routes would limit the available airspace throughout the course of the war (Hopkins, 1979:15). The tactical operations took place over Thailand and the Gulf of Tonkin. The KC-135s were restricted to stay below 19 degrees latitude. The standard offload to the F-105s and F-4s was 8,000 pounds apiece. The fighter refuelings were restricted to 15,000 feet or above. The bombers would refuel at 26,000 feet or above (Hopkins, 1979:21). In both cases the vertical separation was 500 feet, and each B-52 would take up to 80,000 pounds of fuel from his mated tanker. In those instances where a tanker would abort, two tankers would hit three bombers giving the third just enough fuel to reach the post-strike track, where a new tanker would be waiting for him (Hopkins, 1979:34). With as many as 30 bombers and 30 tankers operating in an area at any one time the air refueling procedures had to be

precise. Each track had a north and a south leg 50 nautical miles (nm) apart. As the two forces joined up en-route the pairs would alternate taking the north and south legs, thereby increasing the intervals between aircraft while keeping the formation together. Each leg was approximately 210 nm. At the completion of the pre-strike refueling, several tankers would recover into Clark AFB to act as “Jumping Jack” or emergency post-strike refuelers (Hopkins, 1979:34).

General Momyer and General Crumm’s meeting on July 27, 1966 would shape tanker operations for the remainder of the war. First, the base air refueling altitude was dropped to 15,000 feet and the tracks were extended north of 19 degrees, but in no case were the tanker aircraft to exceed 20 degrees north latitude. It was estimated that this would effectively double the amount of time fighters could spend in the target area. The two agreed that the post-strike tankers could also be designated for the emergency refuelings, and thus ease the requirement for strip alert crews. At this time 7 AF was requiring 3.75 million pounds of fuel a day, but the tankers could only supply up to 2.5 million. Headquarters SAC determined that 3.4 million pounds could be offered up, if they could base 35 KC-135s in Thailand. However, General Momyer was already moving to push the tankers out of the country (Hopkins, 1979:61).

Vietnam Planning Factors

The air refueling operation evolved as the years rolled by due to experience, seasonal differences, and constantly changing operating locations. However, there are some generalizations that can be made in order to examine the operation. The average fuel load was 150,000 pounds (Hopkins, 1979:117). The KC-153A would burn

approximately 15,000 pounds of fuel in the first hour of flight, and 12,000 lbs/hr thereafter. The typical fighter movement would place one KC-135 with four fighters. The average operational sortie would take place in an anchor or orbit with three cells of three tankers each, and each of the nine tankers would service five receivers for a total 54 aircraft. Typically, each tanker would offload 55,000 pounds across seven refuelings (Hopkins, 1979:26).

During the operational control debate between General Momyer and General Crumm, the SAC planners were upset over the high number of weather cancellations (approximately 20%) forcing the tankers to dump the excess fuel to reduce their weight to within the landing limitations. The tankers were needed to turn around and fly follow-on sorties and thus could not loiter. During this debate the planners estimated that the ideal fighter-tanker ratio was 10-1, but they were actually achieving between 7.5 and 8.1 to 1 (Hopkins, 1979:60-61).

Track and Distance Information

The air refueling tracks supporting the bombers began just north of the Philippines and angled to the southwest approximately 300 nautical miles. The tactical tracks were located off the coast of North Vietnam and in the northeastern sector of Thailand, as well as over Laos. For the aircraft from Kadena it was approximately 650nm to the start of the B-52 tracks, and over 1000nm to the tactical tracks over the gulf. To proceed to the Thailand tracks would add another 150nm. The same was true for those tankers out of Taiwan, flying to the coast was 900nm or so. The tankers from Clark AFB had a slightly shorter trip of 650nm to the near side and 800nm to the

Thailand tracks. The Thailand based tankers had a much shorter trip. U-Tapao was the furthest away from the majority of the tactical tracks, and they had to fly just over 300nm to get to the areas. Although these numbers could vary somewhat given the particular mission and routing, they are a good approximation of the distances involved. A 400-knot true airspeed provides a close approximation of the transit time involved.

Overview of KC-135 Operations in Desert Storm

Aerial refueling supported both the deployment of forces to the Area of Operations and the use of these forces in the air campaign. Unlike Vietnam, though, the KC-135 was not the sole provider of fuel. Five countries provided twelve different types of tankers to the conflict. The KC-135's role in this new war actually started prior to the invasion. Based on intelligence reports, two aircraft and a mobile operations center were deployed to Abu Dhabi, on the request of the United Arab Emirates in the hopes of deterring the Iraqis (Keaney, 1993:187). At this time the KC-135 fleet totaled 633 aircraft, and eventually 206 would deploy in theater or 33 percent of the force, and a total of 262 KC-135s or 44 percent of the fleet, operating out of 21 locations in 10 countries would be committed to supporting the war (Keaney, 1993:180). Although it was a multinational force, the allied tankers primarily refueled only their aircraft, with the exception of the U.S. The daily average for the tanker fleet, as a whole, was 360 sorties a day and the U.S. fleet averaged 1,433 receivers a day.

One hundred tankers supported the air bridge operation responsible for the flow of aircraft into and out of theater. The deployment of forces took part in two phases. The first phase was designed to get a force in place to defend Saudi Arabia and took place in

August and September. The second phase was designed to provide a force capable of conducting offensive operations. It began in earnest in late November and was to be completed not later than January 12, 1991 (Keaney, 1993:117-119). Time was the critical element during phase one, and so the movements were non-stop to the maximum extent possible. In order to simplify the air refueling planning, the same route was used for the majority of fighter deployments. The requirements varied between the F-15 that required 7 refuelings apiece to the F-4G requiring 15 air refuelings to fly non-stop from the East Coast into the theater. With the defensive force already in place during the phase two deployments, the planners tried to reduce the demand on the tanker force. They did this by limiting the non-stop deployments from the United States during this phase (Keaney, 1993:123).

The increased capability of the re-engined KC-135, now known as the KC-135R, was used to offset limitations in bed down locations. Given its greater offload capability and performance characteristics, it was initially deployed in theater and the older A models were used for the air bridge. According to the authors of the Gulf War Airpower Survey, “Airspace was the primary limitation for air refueling in Desert Storm” (Keaney, 1993:179). Using the more capable R model decreased the number of aircraft in limited airspace. The report also identified planning, manpower, and employment as areas of interest following the war.

KC-135 Basing Issues during Desert Shield/Desert Storm

Although there were two air bridges established, the Atlantic bridge was by far the busier of the two, and faced significant basing problems. This is because the bridge operated from; RAF Mildenhall, England; Lajes AB, Azores; Zaragoza and Moron AB, Spain; Mont de Marsan, France; Malpensa, Italy; Incirlik AB, Turkey; and Hellenikon and Andravida, Greece. Many of the problems came from fluctuating political positions of the host nations, as well as infrastructure problems. The arrival of KC-135s in France on February 7, 1991 marked the first deployment of U.S. aircraft to France since 1966 (Keaney, 1993:193).

The concept of operations for basing within the theater called for a network of bare bases to have a designated “lead wing” to act as the host and provide the majority of the support. Unfortunately there were no pre-existing basing agreements on the Arabian Peninsula (Keaney, 1993:81). This problem was overcome, but it complicated the initial lay down of forces. Often units didn’t know their eventual location until they departed their home station, and even then it could change en-route. In one example the 4th Fighter Wing deployed to Seeb, Oman, and while over the Mediterranean Sea were told to divert to Dhahran. After arriving there with their three C-141s, they were told to proceed to Thumrait, Oman. In Thumrait they would find conditions considerably different from those they were expecting at Seeb (Keaney, 1993:125).

Within the theater the majority of combat aircraft were based in the southern portion of Saudi Arabia or the Gulf states, which put them between 700 and 1,000 miles from their targets. The B-52 missions ranged from 700 miles up to 2,900 miles from Europe and Diego Garcia (Keaney, 1993:167). Table 4 gives the complete disposition of the KC-135 forces directly supporting the war (Keaney, 1993:118-119).

Table 4. KC-135 Bases during Desert Shield/Storm

Base	Phase I Totals	Phase II Totals
Cairo West, Egypt	3 KC-135R	15 KC-135R
Jeddah, Saudi Arabia	20 KC-135R	27 KC-135A
	20 KC-135E	45 KC-135E
Masirah, Oman	5 KC-135R	10 KC-135R
Diego Garcia	6 KC-135R	5 KC-135R
King Khalid IAP, SA	11 KC-135R	26 KC-135R
	29 KC-135A/Q	22 KC-135A/Q
Riyadh, SA	10 KC-135Q	10 KC-135Q
Al Dhafra, UAE	7 KC-135R	7 KC-135R
Seeb, Oman	5 KC-135R	15 KC-135R
Abu Dhabi		8 KC-135E
Dubai		4 KC-135E
Incirlik, Turkey		4 KC-135A
Total Aircraft	116	198

The Organizational Structure for Desert Shield/Storm

Brigadier General Patrick P. Caruana was designated the Commander Strategic Forces (STRATFOR), and departed in early August to represent the SAC forces in the CENTCOM Area of Operations (AOR). Although the “on-the-shelf” plan called for the aircraft to change operational control to U.S. Central Command’s air component, CENTAF, only the B-52s would in fact switch. Operational control of the tankers would remain with SAC through the historic 8th Air Force and 15th Air Force (Hone, 1993:186). The air refueling wings were the 1701st at Jeddah commanded by an Air National Guard colonel; the 1703rd located at King Khalid International; the 1700th Strategic Wing located at Riyadh, and included several SAC assets besides the KC-135s; the 1702nd based at Seeb, Oman; and the 1712th and 1713th, were both wholly Air National Guard operations located at Abu Dhabi and Dubai respectively. The other units were designated as air refueling squadrons (Hone, 1993:196).

Although 8th and 15th Air Force maintained their command structure to Strategic Air Command, Brigadier General Caruana, Commander 17th Air Division (Provisional) was assigned to the CENTAF staff, along with the tanker planners. The Air Tasking Order was the means by which CENTAF was able to task the various units, and although the tanker planners were part of the process of developing the ATO, they injected their inputs only after the CENTAF planners had developed their requirements. The result was that the tanker planners were usually left with only a few hours to develop their portion of the plan (Olson, 1993:205). The first two days of the air campaign had been meticulously planned, but trouble started to crop up on day three and four due to tanker non-availability and to a lesser extent, the tankers not being in the right places. General Caruana noted after the war, “that after the start of Desert Storm it came almost as a shock to the planners that tankers comprised a limiting factor in air operations” (Hone, 1993:213). General Buster Glosson, 14th Air Division Commander, with responsibility for all attack aircraft in theater, admitted a planning shortfall on this matter (Hone, 1993:213). General Caruana also observed that the tanker planners needed to insert themselves more forcefully into the planning process. The tasking for tankers then changed from dedicating aircraft to particular sorties or packages, to placing them in particular air refueling tracks. This change dropped 20 to 40 aircraft out of the daily planning cycle. The consensus was that around 265 to 275 sorties would be planned each day in this manner, and that would leave approximately 25 additional sorties to fill in trouble spots (Hone, 1993:214). As the final step, the planner, principally responsible for that day’s Air Tasking Order would fly on the Airborne Warning and Control System

(AWACS) to deal with last minute changes. The following passage details the impact and full range of actions provided by these representatives.

They advised the AWACS controllers on the movement of air refueling sources, provided threat advisories to the tanker crews, repositioned tankers for air refueling returning strike forces low on fuel, supported attacking aircraft missions generated on short notice because of real-time changes in the war, and planned fuel requirements for aircraft involved in the search and rescue of downed Allied aircrew members. They also provided input to the tanker planning process by reporting on actual utilization of air refueling assets, thereby improving the assignment of tankers in the ATO process (Olson, 1993:213-214).

Desert Shield/Storm Planning Factors

The General Accounting Office's report, Operation Desert Storm: An Assessment of Aerial Refueling Operational Efficiency, determined that on average 40% of the fuel carried aloft went unused throughout the course of the war. There was a slight improvement as the war progressed. During the first week 41.5% of the fuel went unused, and in the final week the number had dropped to 35%. Interestingly, the KC-10 averaged only 29% unused fuel for the duration (GAO, 1993:6). The report attributed this, at least in part, to the tanker to receiver ratio. The inefficiency was greatest with the F-16, which represented one-third of the U.S. Air Force combat aircraft in theater. Strike plans were scheduling KC-135R's against a maximum of six F-16s and offloading 60,000 pounds. Assuming a four-hour sortie this would equate to only half of the aircraft's available offload. The nighttime ratio was even more restrictive, limited to only four aircraft. The ratio was eventually raised, but never above eight (GAO, 1993:9).

There was no restriction placed on the size of the tanker cells, but the typical strike package refueling from a cell of KC-135s would range between 24 and 36 aircraft

(Keaney, 1993:168). Table 5 breaks down the average daily air refueling statistics for both Desert Shield and Desert Storm.

Table 5. Average Daily KC-135 Air Refueling Statistics

	Desert Shield	Desert Storm
Sorties Flown/Day	66	215
Hours Logged	182	977
Aircraft Refueled	175	839
Fuel Delivered (million pounds)	1.9	11.0

These numbers indicate a tanker to receiver ratio of 2.65 during the build-up, and 3.9 during Desert Storm itself. The average offload per sortie was almost 29,000 pounds per sortie during Desert Shield, and 51,163 for Desert Storm (Olson, 1993:199).

There was a greater diversity of aircraft taking fuel in this conflict than in Vietnam, and this complicates the comparison a little bit. However, Table 6 gives a breakdown of the average on-loads, in pounds of fuel, for the principle combat aircraft participating in the conflict.

Table 6. USAF Receiver Onloads

Receiver	Refueling Events	Total Onload	Average Onload
A-10	3,775	15,756,339	4,174
A-6	2,104	17,457,772	8,297
AC-130	96	1,464,492	15,255
B-52	2,166	137,225,933	63,355
F/A-18	5,933	15,732,300	2,652
F-111	2,687	36,324,595	13,519
F-117	Not Releasable		
F-14	4,085	33,969,581	8,316
F-15	12,281	199,027,795	16,206
F-16	14,219	87,858,252	6,179
F-4	5,061	57,623,629	11,386

Aircrew manning levels were an area of contention between the theater and Strategic Air Command. The KC-135 was manned throughout the Air Force at 1.27 crews per aircraft. CENTAF requested a 2.0 crew ratio, but SAC could not support the request. The trade-off was that prior to the beginning of combat operations the ratio in-theater would be raised to 1.5. Even this number still had an impact on other SAC operations, including the Single Integrated Operation Plan (SIOP) and training (Olson, 1993:204).

The tactics employed by the combat aircraft directly impacted the fuel requirements. One example of excess fuel requirements was discovered accidentally when an F-111 pilot mentioned to his assigned tanker, that they were no longer flying low-altitude missions and did not need post-strike refuelings (GAO, 1993:8). When air superiority was established the commanders moved the bombing altitude up between 10,000 and 15,000 feet (Keaney, 1993:16). The only exception was the A-10. In early

February, their attack altitude was dropped to between 4,000 and 7,000 feet to improve their lethality (Keaney, 1993:21).

The change in altitude not only directly impacted the fuel requirements, but had an indirect consequence as well. Weather was a major factor during Desert Storm. During January and February 1991 the weather was twice as severe as was considered normal (Olson, 1993:87). The single worst day was the fifth day of the air campaign when 400 of approximately 3,000 sorties cancelled (Hone, 1993:225). The trend would continue and by the third week of the war estimates were that half of the attack sorties were either re-directed or cancelled due to weather in the area (Keaney, 1993:16). The switch to higher altitudes for the strikes raised the ceilings required for the attacks. The difference between a 1,000-foot ceiling and a 10,000-foot ceiling was that the targets were obscured 30% more often. The estimate for the entire campaign was 40% of the time targets in Iraq and Kuwait were obscured (Olson, 1993:86).

Airspace and Air Refueling Tracks

The Gulf War Air Power Summary determined that air space congestion was the critical limiting factor for air refueling, and in the CENTAF after-action reports, tankers ‘were “the limiting factor” in generating additional combat missions’ (GAO, 1993:4). Due to the ATO process tanker planners at CENTAF routinely had between 2 and 4 hours to deconflict the airspace, schedule the tankers, and task the units. The size of the strike forces was constrained by the number of tankers that could be scheduled into the air refueling tracks (Olson, 1993:205-206).

The concept of quick-flow refueling was developed to alleviate some of the congestion and utilization problems. The refueling procedure reduced the time each package would spend with their tanker by connecting and disconnecting more rapidly. While one receiver was taking fuel the next in line would wait just off the receiver's wingtip. Following the disconnect, the next aircraft would move quickly into position. This allowed the aircraft to cycle through more quickly, which dropped the requirement for the number of tankers in each package. This procedure pushed the tanker to receiver ratio to twelve to one (Olson, 1993:209).

The United States Navy helped reduce the congestion by shrinking the size of the air refueling orbits. The initial anchors were 20 nautical miles wide by 50 nautical miles long. The navy receivers found it difficult to locate the tankers in the orbits, and after several variations agreed to a twenty-by-twenty nautical mile orbit pattern. Positive feedback from the Navy resulted in modifying all of the Desert Storm air refueling tracks (Olson, 1993:213).

There were 45 tracks laid out in support of the air campaign (GAO, 1993:3). The majority of the tracks were congregated along the Saudi-Iraq border. However, there were tracks across the middle of the country, along the Red Sea, and over the Persian Gulf. The following numbers give an estimation of the distances each base had to traverse in order to get to the border tracks. Given the length of that border, there is some room for variability in these numbers. For instance, to fly from King Khalid International to the majority of the tracks was 250nm, but to use a western track could add on another 250nm.

From Jeddah the majority of the tracks were approximately 550nm. Riyadh was only 250nm away. Seeb, Al Dhafra, Abu Dhabi, and Dubai are close together and range from 600 to 750nm. Flying from Masirah, Oman up north would be over 800nm, and tankers from Cairo West would fly 700 to 800nm depending on the missions. Assuming a 400-knot true airspeed, which would be reasonable regardless of the airframe, would indicate that the flight times were between a half-hour and two hours. These numbers are aggressive because there was a 'highway' system established to flow aircraft in and out of the area. These measurements do not account for the additional flight time required to fly the designated route, but should serve as a reasonable estimate.

Overview of KC-135 Operations in Allied Force

Of the three air campaigns, time was perhaps the biggest influence in Allied Force. The combat operations in Desert Storm lasted only 43 days, compared to 78 days over Serbia and Kosovo. However, there were 168 days to build-up and lay in forces under Desert Shield. Some planning was accomplished prior to the initiation of the Air War Over Serbia (AWOS), and forces were deployed to support a very limited operation, but nothing approaching the scale of Desert Shield. As it became apparent that the campaign would expand, the build-up took place in a very compressed timeframe, and under the pressure of conducting combat operations (Cordesman, 1999:7).

NATO began planning options for the campaign in June of 1998, but the Defense Ministers of the North Atlantic Council did not authorize air strikes until October 13, 1998. Still, hostilities did not begin until 1400 hours Eastern Standard Time on March 24, 1999 (Cordesman, 1999:6-7). The KC-135 deployed once more to support this latest

air campaign. Initially 55 were committed to support Allied Force. Unlike the previous two conflicts, there were KC-135s already assigned to the theater. The 100th Air Refueling Wing is located at Royal Air Force Mildenhall, United Kingdom. Prior to the beginning of the war, NATO Supreme Allied Commander in Europe (SACEUR), General Wesley K. Clark, estimated that the war would be over in three days (Cordesman, 1999:7). Major Scott Mischo, the lead tanker planner, assigned to U.S. Air Forces Europe, developed the tanker support effort based on that assumption. Lieutenant General Short's guidance was to minimize the tanker support required for the operation (Mischo, 2000).

General Clark began to "ratchet up" the pressure almost immediately. Although there was considerable political pressure within NATO to limit those efforts, sorties steadily increased and forces flowed into the theater in support of the increased tempo. By Mid-May, the total number of aircraft supporting the fight had nearly doubled, 272 of which were U.S. strike aircraft (Cordesman, 1999:14). When the air campaign officially ended on June 20, 1999, there were 175 tankers supporting the war effort. This time around there would be no A models involved in the operation, with only the R and E models left in the inventory. There were 151 KC-135s, of which 63 were Reserve-component aircraft (Begert, 1999: 3). With the 546 KC-135s still in service, this equates to a commitment of 28% of the fleet (Kersten, 2000). The Active Duty strength was authorized 294 aircraft, and thus the commitment rate for the Active Duty equaled 30% of that component. The operation was hampered by the weather, short planning times, inadequate staff levels at the headquarters, basing and infrastructure difficulties, as well as crowded airspace (Stickford, 2000).

During the first 34 days of the war, NATO reported that they were averaging 340 sorties per day, with 130 constituting attack sorties. Desert Storm averaged 2,555 sorties a day, with approximately 1,600 attack sorties. However, by day 43 the average had improved to 395 sorties, with 132 strike sorties. The postwar numbers were broken into three phases. During the first four weeks the average was 370 sorties. During the next four weeks, NATO averaged 522 sorties, and in the final three weeks, they reached an average of 585 sorties per day. U.S. Secretary of Defense William S. Cohen testified to Congress that NATO flew a total of 37,225 combat and support sorties. In comparison Desert Storm had a total of 109,870 (Cordesman, 1999:17-18).

The Impact of Weather on Operations

Operations in the Balkans were significantly affected by the weather during the campaign. During the first three weeks of the fight, there were only seven days of favorable weather, as defined in Table 7, and NATO cancelled more than half of their planned strike sorties on 21 of the first 36 days (Cordesman, 1999:22,84).

Table 7. Weather Conditions During Allied Force

<u>Weather</u>	<u>Days</u>	<u>Percentage</u>
Favorable	6	13%
Marginal/ Favorable	14	30%
Marginal	7	15%
Unfavorable/ Marginal	14	30%
Unfavorable	6	13%

Favorable -- Less than 50% cloud cover
 Marginal -- Between 50 – 75% cloud cover
 Unfavorable – Greater than 75% cloud cover

Lieutenant General Begert's estimation following the war was that nearly 20 percent of all strike missions, along with their associated tanker support were cancelled due to weather (Begert, 1999:6).

KC-135 Organizational Structure for Allied Force

In the years following Desert Storm the U.S. Air Force reorganized and with the demise of Strategic Air Command, the KC-135 moved to Air Mobility Command (AMC) in support of U.S. Transportation Command (TRANSCOM). From the beginning of Allied Force, TRANSCOM released operational control to the theater, European Command, of the KC-135 dedicated to combat operations. TRANSCOM did retain operational control over those tankers supporting the air bridge and refueling B-2s basing out of the United States (Mischo, 1999). Therefore, Lieutenant General Short had operational control over the theater aircraft, and exercised it through the Combined Air Operations Center (CAOC) director (Begert, 1999:15).

Through the first half of the campaign the senior tanker representation on the staff at the CAOC was Major Mischo. According to General Begert, "The CAOC was not properly manned for a rapidly expanding air campaign of uncertain duration, and it was slow in expanding a tanker staff sized for Deliberate Forge (Begert, 1999:16).

TRANSCOM deployed Colonel Thomas Stickford and additional planners to address this shortfall. For the first four weeks of the war there were only eight planners to manage the 24-hour operation. The additional planners brought the total up to 31 during the final stages. Although the planners were under the direct control of the task force commander,

Colonel Stickford, like Brigadier General Caruana, saw the need for tanker planners to insert themselves more aggressively in the planning process (Stickford, 2000).

Command and control of the tanker fleet was conducted through a number of air expeditionary wings (AEW) and expeditionary air refueling squadrons (EARS) responsible to the Joint Forces Air Component Commander (JFACC), and he in turn reported to the Joint Task Force Commander (JTF). In some cases this was merely a name change for the in-place forces, but the CONUS based units deploying to the theater would start from scratch. Figure 4 depicts the final command and control structure.

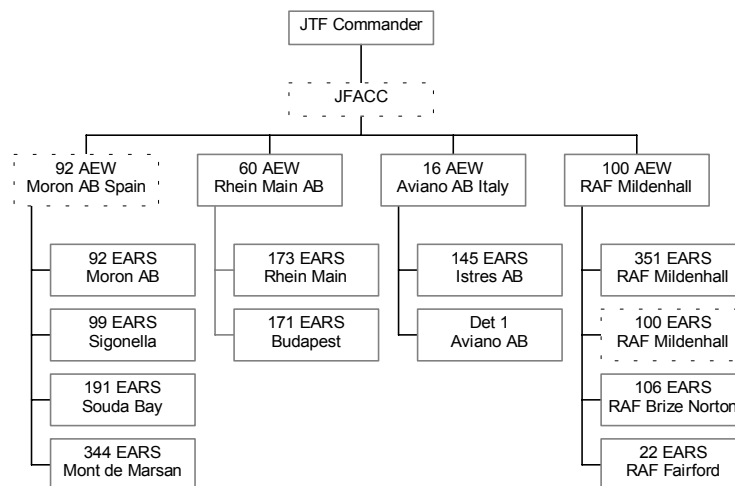


Figure 4. Allied Force Command Structure

The breakdown of aircraft and crews are contained in Table 8.

Table 8. KC-135 Bases during Allied Force

Base	Aircraft Number	Aircraft Type	Crews
Moron AB	26	KC-135 R	54
Sigonella	10	KC-135 R	18
RAF Mildenhall	26	KC-135 R	40
Aviano AB	1	KC-135 R	2
Rhein Main	8	KC-135 R	11
	10	KC-135 E	15
Mont-de-Marsan	12	KC-135 R	21
RAF Brize Norton	5	KC-135 R	18
Incirlik AB	2	KC-135 R	4
Istres AB	8	KC-135 E	13
Budapest	16	KC-135 E	24
Souda Bay	7	KC-135 E	11
Totals	131		231

Mildenhall, Aviano, Istres, Sigonella, and Moron were all planned as bed down locations for the tankers under the initial, more limited plan. The seven additional locations were surveyed and utilized as the war was being fought. Locating suitable airfields was a significant challenge for the USAFE staff. USAFE surveyed over 25 airfields in 15 countries (Begert, 1999). Although the location choices would impact available offloads, the time compression and limited staff (the additional planners and senior leadership had not yet arrived) required that the additional KC-135 numbers were determined prior to a final decision about which airfields would be used (Stickford, 2000).

Planning Factors

EUCOM requested a KC-135 crew manning ratio of 1.8 for the campaign, but settled, initially, on 1.5. However, as the flying hours for each crew started to approach the monthly limits, the ratio was increased to 2.0 (Begert, 1999:7). Based on Table 8 the final tally ended up closer to 1.8 than 2.0. The crew ratio drove the Presidential Selective

Reserve Call-up (PRSC) on April 27, 1999. Approximately 2,400 personnel were activated (Mischo, 1999). By comparison, during Desert Storm 80 KC-135s and approximately 5,000 personnel were called-up for KC-135 operations (Olson, 1993:178).

The total tanker force flew 4,324 sorties, and offloaded 188,095,800 pounds of fuel to 17,751 receivers (Begert, 1999:7). This amounts to a 4.10 receiver to tanker ratio, and approximately 43,000 pounds offloaded per sortie. When the initial plan was devised, the planners sought a 1.5 utilization rate for the tail numbers, but the average over the course of the war worked out to be less than 1.0, or less than one sortie per aircraft per day (Mischo, 1999). This plan was developed with the distant Moron and Mildenhall figured into the equation.

The limitations on airspace were three-fold. The air refueling tracks were overcrowded, there were restrictions on routing combat aircraft, and there were conflicts with civilian traffic, which continued to fly in and around the AOR. The air refueling plan was shaped from Deliberate Forge, the Allied action in Bosnia. There were incremental adjustments to that basic plan, until May 1, 1999 when a re-designed plan was put into place (Begert, 1999:10). The tanker planners placed a restriction of three tankers to a cell to help minimize the impact on the limited airspace (Mischo, 1999). Once again the 10,000 – 15,000 foot bombing altitude restriction was put into effect (Cordesman, 1999:59).

The planners had 19 air refueling areas available to them, although some were used more extensively than others. The planners averaged between 6 and 10 tankers for each strike package. As an example of the planning methodology, Major Mischo offered the following example. Within a twelve-hour period, a two-ship of F-16s would require

three refuelings, and the CAOC would use six KC-135s to accomplish the offloads. The planners estimated approximately 6,000 pounds to each receiver per refueling (Mischo, 1999).

Similar to the Jumping Jack missions and alert aircraft at Andersen AFB, Guam during the Vietnam War, Allied Force employed four alert aircraft. Two were stationed at Sigonella, one was located at Istres, and the final one was maintained at Aviano. The total number of tail numbers requested was based on an 80 percent mission capable rate. This means that if eight aircraft were needed then 10 would be deployed. The actual rate was extremely close at 78% for the duration of the war (Mischo, 1999). Each of the bases had an ability to turn the aircraft to generate additional sorties within a 24-hour execution cycle. The bases closest to Serbia were able to fly the majority of the aircraft twice, and the further away the base was, the smaller the utilization rate. Mildenhall and Moron, the two main tanker bases, were only able to turn a few aircraft each day to a second sortie (Mischo, 1999).

The ATO planning cycle was not much different than during Desert Storm. Planning for a given day would start approximately 36 hours prior to execution, with the initial air refueling requests loaded into the system 24 hours prior. The plan would be complete approximately 18 hours early, and the final plan would be released 12 hours before the start of the ATO. However, the units' ability to receive the ATO varied significantly, and this coupled with the inevitable changes further reduced the amount of time each of the wings had to plan the individual sorties (Mischo, 1999).

Air Refueling Tracks and Distances

The majority of the air refueling took place over the Adriatic Sea in the 19 tracks established by the CAOC. As in Desert Storm, there was a specified route to flow aircraft into and out of the area and avoid politically sensitive areas. This route system added flight time on to the sorties and further reduced potential offloads. Major Mischo estimated that the Moron and Mildenhall aircraft had a three-hour trip each way. This is still close to what a direct trip at 400 knots true would take, and these were the longest flights. The other two U.K. based units had similar flight times. Incirlik was not far behind with almost 1000nm to fly. Mont de Marsan was 770nm away from the tracks. Budapest was 500nm away, and Souda Bay and Rhein Main were 420nm out. Istres was also a bit of a drive at 520nm, but Sigonella was only 350nm. The alert bird at Aviano was under that, although the more southern tracks would still take a little while to reach.

III. Organization of the Tanker Operations

The first research question seeks to examine the organization of the tanker units. The structures in each of the three operations were similar, and follow a very traditional military lay out. However, there are some differences between the three conflicts. The change of operational control is the most contentious issue, and has been from the beginning of air refueling operations, as witnessed during the 'Hightide' test in Korea. During both Desert Storm and Vietnam, SAC maintained operational control of their tankers, although they were willing to relinquish control of their bombers during Desert Storm. In all three cases the parent command provided tanker expertise to the CINC's staff to help with the planning. The one difference is that the planners in Allied Force served as augmentees to an existing capability.

The change in operational control affects the parent command's ability to recall those forces to support other operations, but it does not necessarily impact their decision to commit forces to the theater. The assumption is that if a commander knows he can recall those aircraft on a moments notice, he will be more likely to commit additional forces to an operation. However, there was no documentation on any of the conflicts to suggest that operational control had any bearing on the decision of how many aircraft to send. The only debate that seemed to come up was during Vietnam, when the PACAF commander wanted to expose the tankers to greater risk in order to increase their effectiveness. SAC was hesitant because of the potential impact on their ability to support the SIOP should the need arise. Because operational control had not changed, SAC was able to have the final word on how the aircraft were employed.

Where the operational authority resides had an impact on the philosophy of supplying the fuel. In Vietnam there was a debate between PACAF and SAC over the planning process. The debate centered around how much fuel could be provided if the requirement was viewed as tail numbers supplying a given amount of fuel to a set of receivers (PACAF's viewpoint) or as a total amount of available fuel to satisfy the requirements (SAC's view). This differing viewpoint led to a conference on the matter. It is difficult to know if the debate would have taken place had the assets been under the direct control of PACAF, but the same issue came up in the subsequent conflicts as well, and will be further discussed in Chapter 5.

The organization of the units appears to be dictated more by the basing constraints and is a lagging indicator. In each case a deployed wing structure was implemented under the numbered air forces, with smaller units designated as squadrons or detachments reporting back to the main operating bases. Every indication in each example was that the organization came about as a result of where the aircraft were deployed.

In all three operations there were concerns over the limited amount of time to plan the sorties, but this appears to have roots other than in the organizational structure. The SACLO office during Vietnam had some initial problems because of classification issues. The solution was not related to an organizational change, but rather a planning change. By removing certain data, SACLO was able to transmit the sortie information directly to the wings rather than through 3 AD. In all three cases the planning process stayed in theater (although some B-52 planning took place at Offutt AFB during Vietnam). Thus, the organizational influences were entirely within the theaters, and there is little

difference between the three conflicts. The manning levels did hamper the cycle time early in the Air War Over Serbia. Allied Force showed a marked improvement over the previous two campaigns in the planning cycle time. However, the workload for eight people on a continuous 24-hour cycle negated any benefits received from the quicker process. This limitation was corrected with the arrival of 23 additional bodies.

In the latter two cases the tanker planners were actually working for the theater commander, and in Vietnam they were merely a liaison to the staff. However, in both Desert Storm and Allied Force, the senior leadership thought the planners could have been more assertive during the planning process in order to improve the tanker support. Unfortunately there is not enough information to indicate whether or not the change in organization had anything to do with the twice-noted characteristic.

The change in operational control is the major difference in the organization of the forces, but even in those conflicts where the aircraft did not fall under the theater's control, there were distinctions between the forces based on missions. In Vietnam there was an initial and brief attempt to segregate the tankers based on whether or not they supported tactical sorties or the Arc Light bombing missions. Within the theater, the wings were given areas of primary responsibility. The wing at U-Tapao was primarily responsible for the Young Tiger missions, and the Kadena outfit managed the SAC bombing missions. This arrangement was logical based on the locations of the aircraft around the theater, and did not preclude tankers from either wing supporting any type of mission. Both wings were still managed by 3 AD and then 8 AF, and the force structure was determined by Headquarters SAC.

In Desert Storm the location also had a lot to do with which units supported which missions, but there was nothing to preclude a Riyadh based tanker from refueling B-52s out of Diego Garcia or Great Britain. The air bridge operation was managed by Headquarters SAC, who also maintained control of the tankers in theater, and this is very similar to the set up for Vietnam. Allied Force was the most diverse of the three because TRANSCOM released the units to EUCOM. TRANSCOM then supported the B-2 strikes and air bridge operations with additional tankers. However, there doesn't seem to be any change in the number of tankers used in those operations because of the split. Regardless of the change in operational control, the units supporting the air bridge remained separate from those conducting combat operations.

IV. Supervision of Tanker Operations

The second research question is how were the KC-135 operations supervised in each of the conflicts? Central to that discussion is who did the supervising, and thus the organizational layout of the operations has an impact. Supervising the force includes the senior leadership, but it also includes the staff. Were they manned properly, and were they able to track the use of their forces? After all, capturing the data is the first step in determining either the efficient or effective use of the assets. Supervising the force involves the planning process as well. The Air Tasking Order (ATO) was the means by which each headquarters controlled all of the aircraft. In each case there was a lengthy, and sometimes elaborate, process for developing this tool every day.

Although prior to the deployment to Kadena of KC-135s, the 3 AD had not been responsible for tanker operations before, they were a standing SAC organization already in theater. Throughout the war the staff of 3 AD would monitor tanker operations, along with those of other SAC forces. Although the exact staffing levels are not known, there is some value having a staff already familiar with the theater in place. The units themselves were rotating every 60 or 90 days depending on the mission. The exception was a portion of the Kadena force that eventually became permanent party during the course of the war. Both of these arrangements provided continuity to the operation.

The SACLO was another key element of supervision. These liaison officers were responsible for developing the air refueling plan each day, and forwarding it to the units. They also had the responsibility for educating the tactical forces on air refueling procedures, capabilities, and limitations. With the removal of Top Secret information

from the daily tasking order, SACLO no longer had to go through 3 AD to task the units. This gave the staff a great deal of influence over the tanker operations, and as such were the key players at the SAC/ PACAF conferences.

The system was nearly identical during Desert Storm, only on a larger scale. Instead of one, there were two numbered air forces running tanker operations for the war, and the liaison team was led by a brigadier general. SAC maintained control of the forces, but a great deal of responsibility was placed on General Caruana. Placed under CENTCOM's command, as the STRATFOR and 17th AD Commander, he was responsible for the supervision of all SAC aircraft, even though most were not under his command. The planning staff was also placed under CENTCOM, and this gave General Schwarzkopf control of the assets through the ATO.

The planners, as in Vietnam, put together the tanker plan after receiving the requirements from the other aircraft communities. This left them little time in the process to work out the details of their support plan. As in all three conflicts, the complaint was that there was only a matter of a few hours to work through a very complicated plan. After trouble started to appear on days three and four of Desert Storm, General Glosson changed the concept of operations for the tankers and this simplified their actions somewhat. However, this action only made the ATO process manageable. It did not free up additional time in the process to examine what was actually happening. The GAO report pointed out that the tankers were returning with nearly half of their fuel unused, but the planners did not have the time or resources to capture that kind of data and interpret it. Again the GAO report pointed out that the only way the staff became aware of some changes in requirements was through chance remarks between aircraft in the

field. The staff was able to quickly identify problems supporting combat operations, but was unable to evaluate some of the finer points of their operations.

The same situation was documented during Allied Force. Initially supervision was left to personnel assigned to EUCOM. Faced with both receiving and employing the tanker fleet, and lacking any link back to AMC, these eight planners were quickly overwhelmed with the growing campaign. Eventually Colonel Stickford and additional staff planners joined the JFACC's staff to aid in supervising the employment of the force. Although they set a number of initiatives in motion to capture the sortie data, it was too late in the campaign to have a major impact.

The ATO process was nearly identical to the Desert Storm process, although the use of orbits was not implemented. Developing specific tanker sorties to support specific combat missions complicates the planning process, but did not keep the operation from being effective. The ATO was released to the units at approximately the same time as in the previous two conflicts.

In the earlier two conflicts there was a division in the supervision that was missing in Allied Force. The planning function was separate from the other supervisory functions. In Vietnam SACLO, and later ADVON were in Saigon working the day-to-day sorties and the 3 AD staff at Andersen AFB was able to supervise the wings and the planning staff. In Desert Storm the planners were assigned to CENTAF to work the missions and 8th and 15th AF staffs were again able to keep an eye on the operation as a whole. In Allied Force the JFACC's staff headed up by Major Mischo, and later Colonel Stickford, had to plan and supervise the deployed units. There were no numbered air forces to take the long view. With eight personnel fulfilling both roles, it is unlikely that

a detailed examination of the force structure issues could take place. Colonel Stickford's immediate focus on those issues indicates that the supervision was inadequate prior to his arrival, to perform both jobs.

V. The Planning Process

The final research question investigates the planning processes in the three campaigns. The planning process is intertwined with the organizational structure and supervision of the force. It does not happen in a vacuum, but rather in concert with these influences. Planning support for each of these operations is a complex and difficult undertaking. The impact of doing it poorly was illustrated at Kadena, as the 32 tankers began arriving after only 24 hours notice and the base fell into 'chaos'. The planning process incorporates far more than just receiving aircraft into a location though. In order to provide adequate support, it is necessary to determine how many tankers will be required, where they will be (or can be) located, which tankers will support which missions, and how will the plan be implemented.

The logical place to start is to determine what is the requirement for fuel, and then figure out how many aircraft are required to supply it. Experience has shown that it's not that easy. The requirement is determined by the receivers, and estimating their requirements can be challenging prior to the fight starting. Vietnam was the only war to express the requirement in terms of total fuel required on a daily basis, but even this was after several years of operations and some prodding by the SAC planners. The Desert Storm planners were forced to treat fuel in this manner, but due mainly to the complexity of the operation. Lacking an overall requirement, it becomes necessary to match up individual mission requirements to tanker capabilities, as was the case in Allied Force. However, there are some educated guesses that can be made based on historical evidence, if it is captured and disseminated. An F-16 uses just about the same amount of fuel today

as it did in Desert Storm. Therefore, it is possible to reasonably estimate average mission requirements prior to the start of hostilities. That information will also help planners evaluate the accuracy of the requests from the receivers.

An examination of typical sortie data should help clarify the impact of these two different approaches. In Vietnam the A model tankers were taking off with an average of 150,000 pounds of fuel. Assuming that the aircraft were landing with 20,000 pounds as reserves, this would make 130,000 pounds available for use and offload. The KC-135A burns approximately 15,000 pounds in the first hour and 12,000 or so in each additional hour. Given that the average was a 55,000 pound offload to seven receivers, then the average sortie duration would be between five and six hours. This assumes that no unused fuel was returned. This is an unlikely assumption given the experiences of Desert Storm. The amount would vary depending on the base and location of the track.

For those missions from Kadena, Taiwan, and Clark, the duration would be six hours or maybe longer. The Thailand tankers were not burning as much traveling to and from the air refueling tracks, and so had more to give. With a travel time between 30 and 45 minutes, these tankers would have an additional 12,000 pounds of fuel per hour they did not have to fly. Assuming a four-hour sortie, one-hour transit time and three hours refueling, loitering and maneuvering, the Thailand tankers would have approximately 80,000 pounds of fuel to offload. The fighters of that day averaged an 8,000 pound onload, which equates to a 10 to 1 ratio, the ideal desired by SAC. The offer of 3.5 million pounds per day with 35 tankers in Thailand supports these numbers as well. However, with a tanker to receiver ratio on the whole closer to 4 to 1, the KC-135s were offloading less than half of the available. The ratio was a little better when just the

tactical missions were evaluated. That ratio was between 7 and 8, which equates to 56,000 to 64,000 pounds offloaded from 80,000 to 90,000 available.

Using the Allied Force example offered by Major Mischo, the R model KC-135 is capable of at least 180,000 pounds out of Mildenhall at that time of year. Again assuming a 20,000 pound fuel reserve (anything lower only improves the capability of either model), the KC-135 has 160,000 pounds of useable fuel. The trip to and from the airfield was six hours and would cause the aircraft to use approximately 60,000 pounds itself. This puts the tanker in the tracks with 100,000 pounds to burn or offload. If the tanker arrived to provide the initial refueling to the F-16 two-ship, cited previously, the tanker would offload approximately 12,000 pounds of fuel. The two-ship would require another 12,000 pounds in four hours. At the end of this second refueling the tanker would still have approximately 36,000 pounds of fuel to use in the area. If the receivers' request doubled, the single tanker could still provide the majority of the offload and return home. Therefore the entire requirement could be satisfied with two KC-135s as opposed to the six used by Allied Force planners (Mischo, 1999).

There are several other options. If that fuel can be diverted to other receivers, the tanker could maneuver for two additional hours, over and above the four hours spent loitering between the two refuelings, and still have 16,000 pounds to offload. The first tanker could hit other receivers immediately following the F-16 refueling until reaching his limit and leave the subsequent refuelings of the F-16s to other tankers. The benefit of this approach is that it does not leave the tanker idle in an orbit, waiting for the next refueling. There is also the approach used in Vietnam where that tanker could serve as the alert tanker, and thus lower the requirement. The final option is to have the tanker

return home because he doesn't have the capability to satisfy the final air refueling for these two receivers. In this instance the tanker would recover with 36 percent of its available offload, a number close to that of Desert Storm. However, it is only 23 percent of the fuel available on that sortie, and that compares favorably to Desert Storm.

Table 9 provides a comparison of the three conflicts in terms of the daily performance of the KC-135 fleet. September 1972 was the most intense portion of the Vietnam War in terms of air refueling, and is similar to the other two conflicts in terms of the rapid build up of tanker forces.

Table 9. Average Daily Air Refueling Statistics

	September'72	Desert Storm	Allied Force
Aircraft	172	206	151
Time Frame (Days)	30	42	78
Sorties	3,902	9,030	4,324
Receivers	12,509	35,238	17,751
Total Offload	159,600,000	462,000,000	188,095,800
Tanker/Receiver Ratio	3.21	3.90	4.11
Offload per Sortie	40,902	51,163	43,500
Sorties per Day	130	215	55

Any comparison of these numbers must bear in mind the differences in time as well as the airframes involved. The tanker to receiver ratio could also be misleading. The involvement of larger aircraft will bring that number down, as all three models of KC-135s are likely to only refuel a single 'heavy' aircraft on a sortie. One third of the sorties in September 1972 were B-52 support, whereas, the majority of the B-2 support was provided by tankers not included in the Allied Force numbers, and thus brings down the ratio for Vietnam and helps the ratio for Allied Force.

The plan for basing of tankers was varied in all three operations. The time compression grew worse in each conflict. All three operations had to deal with constraints, although the Arabian Peninsula did offer some very capable airfields, the vast majority were at least 600nm away from the majority of the air refueling tracks. Both Kadena and Ching Chuan King were major bases with distance problems similar to those of Mildenhall and Moron, but the Vietnam planners were able to offset the disadvantage with U-Tapao. The Allied Force planners were forced to sprinkle small units at the 400 to 500 nm range to try and counterbalance the Moron and Mildenhall issues.

In both Vietnam and Allied Force the tanker representatives had a constant battle to keep the tankers close to the action. Although the operation in Vietnam had time to make improvements in the existing infrastructure, many times the tempo of operations would force the tankers to operate without those improvements. In all cases the use of civilian fields was essential to the bed down of the force. In each case there was also political pressure from the host nations to limit the U.S. presence at those same civilian airports. Both CENTAF and USAFE planners underestimated the tanker commitment required for their operations. In both cases this resulted from an underestimation of the nature of the combat operations, and the planners were left scrambling to find airfields to put the tankers into. The tradeoff between basing and offload will play a major role in determining the number of aircraft required to satisfy the demand for fuel. Although the relationship was an issue for PACAF and SAC in Vietnam, there is no evidence that the force structure would have been any different given a different bed down plan. The Hawaii conference recognized the increased capabilities of the Thailand based tankers, but the fuel required was still above the fuel available, so basing would not have reduced

the number of deployed tankers in this case, and PACAF was already planning to move the tankers further out.

Although the CENTAF planners had 5½ months to work out their support plan, the authors of the Gulf War Air Power Survey concluded that airspace was the factor that limited the number of tankers upwards. There just wasn't room for more tankers in the air refueling areas. The need for available booms limited the number downwards. The strike packages needed a quick cycle time across the boom, and thus required additional aircraft, where fewer could have met the fuel requirements. Allied Force planners determined the aircraft needed to supply the required fuel prior to knowing bed down locations, but based on reasonable assumptions of the distances involved.

VI. Conclusion

After a review of these three air campaigns the initial research question remains; how does the Air Force know if its KC-135 fleet is being employed in the most efficient manner possible? The answer is that there is not an established or even an agreed upon approach with which to make such a determination. The analysis shows that the only efforts to evaluate the force structure supporting the operations came about at the Hawaii conference in Vietnam and the GAO report following Desert Storm. Colonel Stickford limited the potential increase of tankers in Allied Force during the latter stages, but had to rely on his experience and rank, in part, to support his decision to those with non-tanker backgrounds, precisely because there were no accepted standards or measures that a junior officer could use.

This lack of an accepted standard impacted all three operations. A comparison of the three conflicts reveals not only this fact, but provides some insight into how the efficiency of the tanker fleet might be determined. Each of these three air campaigns relied on KC-135s to conduct combat operations. The three settings were diverse, ranging from desert, to jungle, to mountainous terrain. Vietnam lasted nine years and Allied Force went from start to finish in 78 days. The tanker underwent some significant changes in the intervening years as well. The upgraded engines allowed operations out of shorter airfields, and increased the available offload over longer ranges. The campaigns varied too. In Vietnam the tempo would ebb and flow with the politics of the war. In Desert Storm the air campaign was intense and overwhelming from the beginning, and in Allied Force a small limited action swelled very quickly.

The similarities are striking however. All three faced infrastructure problems and battles over how close to base the force. Crowded airspace and conflicts with commercial air routes were challenges to be dealt with. The planners in Saudi Arabia were fortunate to be able to suspend commercial travel within that airspace during the hostilities, but faced political pressure to allow travel during the pilgrimages in March. The weather hampered operations in all three regions. Both Desert Storm and Allied Force experienced poor weather on 40 percent of the days, and each of the conflicts estimated approximately 20 percent of the missions were cancelled due to weather. Attacking from 15,000 feet, in Saudi Arabia and Serbia, further increased the impact of weather. During Desert Storm this change in altitude decreased the favorable weather by 30 percent.

The structure of the organizations was similar. Each operation had to contend with geographically separated units and communicating over great distances. Only during Allied Force was operational control given to the theater commander. The planning staff slowly migrated over the years from a liaison office receiving requests from the supported units to a full member of the theater commander's staff. However, there is some indication that complete integration has not been achieved. This migration has had the added effect of removing the planners from an environment where air refueling is thoroughly understood, and placed them in one where the tanker planners are the only individuals with an in-depth knowledge. This situation further increases the need for a uniform set of measures.

The level of senior leadership also varied. During Vietnam 3 AD was commanded by brigadier, lieutenant, and major generals. In Desert Storm, the numbered

air forces commanding the tankers possessed an equivalent rank structure, and SAC deployed a brigadier general to CENTAF's staff. During Allied Force the air refueling wings answered directly to the JFACC's staff, with colonels and brigadier general selects commanding those wings. For a time the senior representation on staff was a major, until AMC deployed a colonel to act as the tanker director. These two factors place an even greater emphasis on developing universally accepted measures. Without a method to quantify and evaluate the tanker operation, the planners and supervision must rely on experience and rank to support their arguments. The migration to a more integrated force, resulting in more junior officers on the staff, increases the difficulty of that task.

The result of the supervision makeup during the Vietnam War was that when conflicts arose concerning tanker issues, the tanker units were able to negotiate an agreement. However, not being under the theater commander had its drawbacks. SAC was not always willing to spend money to fix problems in that region, and PACAF could severely impact the basing plan. During Desert Storm, tactical control was maintained at CENTAF, even though operational control was still exercised by SAC. This command arrangement still provided the KC-135 forces with an umbrella that thoroughly understood tanker operations. General Caruana's comment regarding how surprised the other commanders were that air refueling could be the limiting factor is indicative of the level of understanding of refueling operations by those without a background in it.

In Allied Force the umbrella was removed for the first time, at least directly. USTRANSCOM was able to monitor the operation to a certain extent, but until the arrival of Colonel Stickford, Major Mischo was left to address air refueling issues, such

as force structure, to the commander without the benefit of any established tools to support his decisions.

The comparison does indicate a significant difference in performance of the tanker force between Allied Force and the other two previous conflicts despite the similarities of issues. The biggest difference between the three operations was the approach to planning. In both Desert Storm and Vietnam the fuel was treated as an aggregate amount to fulfill an aggregate requirement. This approach allows the planners to spread out the fuel and get the greatest efficiency from each sortie. During Allied Force the tankers were assigned to support a specific mission. This induces a higher level of inefficiency into the utilization of the aircraft. It is the difference between planning a sortie based on time and planning a sortie based on phase. In using the time method a tanker will hit as many receivers as possible given his fuel load. In planning against a phase, the planners will dedicate a tanker to supporting a specific phase of the operation such as defensive counter air or suppression of enemy air defenses (SEAD). In using this last approach it is only by chance that a tanker will be utilized to its fullest capacity.

During the course of each air campaign the tankers faced many challenges, and although each campaign proved successful, there is some disparity over the way the tankers supported them. A review of Table 9 provides some insight into those differences. In comparison to Desert Storm, Vietnam utilized 15 percent fewer aircraft, and Allied Force was 25% lower than the 206 KC-135s in Saudi Arabia. With 12 more days in Saudi Arabia, the desert tankers accomplished almost triple the production of Vietnam. They put up three times more sorties, serviced three times the number of

receivers, and offloaded almost three times the amount of fuel. The additional tails, increased capability of the newer models, and more suitable basing arrangements account for the improvement. There is also some indication of greater production on the individual sorties in the Gulf. The Desert Storm tankers were servicing more receivers per sortie, offloading more gas from each aircraft, and operating at a utilization rate over 1.0.

The comparison is less favorable for Allied Force. Although the force was 25% smaller than Desert Storm and 13% smaller than Vietnam, it was the most capable KC-135 force assembled. In almost twice the time of Desert Storm, and nearly three times as long as Vietnam's biggest month, Allied Force put up less than half the sorties of Desert Storm, and only a third more than in Southeast Asia. They serviced half the number of receivers compared to the desert and forty percent more than in Vietnam. The offload was also less than half of that of Desert Storm, and nearly equivalent to Vietnam. On the surface the tanker to receiver ratio seems favorable. However, only Vietnam separated out the tactical refuelings from the bomber sorties. The numbers shown in Table 9 are totals and so Vietnam, with the more intense bombing campaign will have a lower ratio. Most of the heavy bomber sorties are not included in the Allied Force numbers because those missions fell under USTRANSCOM. The SAC planners figured that the ratio was between seven and eight for the fighter aircraft, and this is close to double Desert Storm or Allied Force. The offload per sortie was comparable to the other two conflicts. There was a distance factor to overcome in Allied Force, but Vietnam had a similar disadvantage. In Europe the aircraft were more efficient and carrying more fuel per

sortie. The expectation is that the numbers would be higher. Finally the utilization rate is significantly below that of the other two conflicts.

The more capable Allied Force KC-135 fleet under produced over a greater time period compared to the other two conflicts. The individual sortie numbers are closer to par with the other two operations, but below what would be expected from the R and E models despite the longer distances. The only significant difference between Allied Force and the other two operations was the manner in which the planners treated the fuel requirements. Allied Force was the only operation that continued to assign tankers to specific missions to satisfy individual requests, rather than use the minimum force to supply an aggregate amount of fuel within the given ATO period. However, far from an indictment of the Allied Force planners, the tanker planners in Desert Storm did the same thing for the first two days of the war, but were forced to change their approach when they could no longer keep up with the pace of the air campaign. In Vietnam, that very issue was at the heart of a conference between PACAF and SAC, so there is a recurring theme. Colonel Stickford's arrival in theater for Allied Force started to switch the focus there as well. However, the campaign was in its final stages by that time.

If there were established measures of sortie efficiency and production that supported the tried and true method of planning the fuel in the aggregate, then the Allied Force planners would have been able to identify this tendency towards under production. Additionally, they would have been in a better position to support their argument of limiting the number of tankers in theater to their boss, the JFACC.

The most striking realization in this comparative study is that while there is a great deal of effort to capture the successes of the tanker fleet – amount of fuel offloaded,

number of receivers, and sorties flown there is little or no effort to put that information into any context. The General Accounting Office measured unused fuel as a means of evaluating the efficiency of the operation. However, in no case was a systematic method identified to capture missed or cancelled air refuelings, measure the unused fuel, or the number of receivers an individual aircraft was servicing; and only in Vietnam was the total available fuel ever compared to the total requirement for fuel. This leaves a large gap in the overall picture, and deprives the planners and supervision of some very powerful tools to support their decisions on how to employ the KC-135.

Recommendation

Given the importance of air refueling in virtually all operations, and the limited nature of the resource, an effort must be made to manage the force efficiently. Combined with that is the current doctrine of changing operational control to a theater, significantly less familiar with tanker operations, and those who are managing that force are placed at a disadvantage. Therefore, it is necessary to develop a set of measures or metrics to evaluate the efficiency of tanker missions during an operation. Certainly combat effectiveness can never be sacrificed in the name of efficiency, but it should be measured and evaluated. Doing so provides a number of benefits. Planners have a means of evaluating their performance. They also have a powerful tool to support their decisions on employment of the force. It provides a method of comparison across various operations. Finally, it offers USTRANSCOM and AMC a reference point to adjust doctrine and tactics.

Capturing the unused fuel from each sortie is one measure, but does not paint a complete picture. The requirement for 'booms in the air' may dictate that more fuel is carried aloft than need be, and thus boost the unused fuel numbers. Planners can also capture planned versus actual offload information to determine the accuracy of requests. This measure will take time to have an impact as the data has to build up.

The utilization rate is a maintenance metric designed to measure the production the units are getting out of their aircraft on the ground, but what measures the production each aircraft achieves on a mission? The tanker to receiver ratio is helpful in determining the production each sortie is achieving, but to be truly beneficial the numbers should be evaluated against just fighter aircraft, as well as the whole. Some operations may use heavy receivers more than others, and this could skew the numbers. The offload per sortie adds to the overall understanding of how efficiently the aircraft is being used, but can vary given a variety of factors. Basing or surge operations may limit the portion of fuel an individual tanker can offload. However, when coupled to the tanker to receiver ratio the production and efficiency picture becomes clearer.

The best measure for an individual sortie, an individual base, or an operation is the total fuel available versus the total fuel required. If on a given sortie a KC-135 is returning with half of his fuel still in his tanks then there are lost combat or support sorties in those tanks. If each day a wing determines its fuel available for that ATO cycle and only half of it is used, then there are also lost sorties, and the same is true for the entire operation. Capturing and evaluating that data is consistent with the planning approaches adopted in Southeast and Southwest Asia. Incorporating that information into situation reporting and after action reports will drive future commanders and

planners to examine their performance in those terms. It does not preclude accepting a level of inefficiency in order to achieve a necessary level of effectiveness, but provides a context in which to examine force structure decisions.

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Vita

Major John G. Payne was born on 28 March 1966 in Frederick, Maryland. He graduated from Little Miami High School in Morrow, Ohio in May 1984. He entered undergraduate studies at the United States Air Force Academy in Colorado Springs, Colorado, where he received a Bachelor of Science degree in Engineering in June 1988, and was commissioned in the U.S. Air Force. He received a Master of Business Administration degree from Webster University in Saint Louis, Missouri in May 1999.

His first assignment was at Laughlin AFB as a student in Undergraduate Pilot Training in August 1988. In March 1990 he was assigned to Plattsburgh AFB, NY as a co-pilot in the KC-135. While stationed at Plattsburgh he held positions as Standardization and Evaluation Co-Pilot, Aircraft Commander, and Flight Commander. In 1994 he transferred to McConnell AFB, KS. While there he upgraded to instructor pilot, was receiver qualified in the KC-135 RT, and held positions as the 350th Air Refueling Squadron Chief of Training Flight, 22nd Operations Group Mobility Officer, Special Operations Flight Commander, and the 22nd Air Refueling Wing Executive Officer.

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